US Army Corps of Engineers®

Ice Engineering

U.S. Army Cold Regions Research and Engineering Laboratory, Hanover, New Hampshire

Ice Jams, Winter 1998–1999

Ice jams are accumulations of ice in rivers that restrict water flow. Ice jams can cause destructive floods that are costly to riverine communities. Areas below the ice jam can also be affected when the jam releases, sending water and ice downstream. The rapid increase in water levels associated with jams often leaves little time to prepare for flooding. Damages caused by ice jams can be great, affecting roads, bridges, buildings, and homes (Fig. 1).

Accurate and reliable ice jam data are essential to the work of engineers in preventing and alleviating the damages caused by ice jams. The Cold Regions Research and Engineering Laboratory (CRREL) Ice Jam Database is a compilation of freezeup and breakup ice jam events in the United States (White 1999a). Currently there are nearly 12,000 records in the database, with the earliest account dating from 1780. For each ice jam event, the database provides the river name, city, state, jam date, jam type, damages, a short description, a listing of publications, latitude and longitude, U.S. Geological Survey hydrological unit code, and USGS gage number, if available. Many entries rely on annual USGS Water Resources reports (USGS 1999) and other USGS gaging station data. Information also comes from newspapers, books, historical records, trip reports, and other historical accounts of ice jams. The Ice Jam Database is a useful tool in characterizing ice jams for specific areas and for providing information during emergency ice jam flood situations.

This *Ice Engineering Information Exchange Bulletin* provides a brief summary of CRREL Ice Jam Database entries for water year 1999. Currently, there are 62 entries in the database for water year 1999, significantly fewer than in years past. A substantial amount of the information on ice jams in 1999 came from National Weather Service Bulletins. Other sources include CRREL trip reports, Corps reports, and newspaper articles. Of the 1999 events, 61% have some reported damages, including flooding and other damages to homes, roads, cars, and buildings. However, none of the entries for 1999 provide dollar amounts for damages. It is extremely important to obtain this information to determine more clearly the effects of ice jams.

Figure 1. Surrounding areas were flooded when ice destroyed the Tunbridge Mill covered bridge in March 1999.

When did ice jams occur in 1999?

The greatest number of ice jams in 1999 occurred during January and March, composing 95% of the events entered in the database. During January 1999, in which 73% of the 1999 events occurred, the most reported ice jams occurred on the 24th (38%) (Fig. 2 and 3). During March the most ice jams occurred on the 4th (36%). Weather patterns during January created favorable conditions for ice jams when warmer temperatures and heavy precipitation created above-normal stream-flow in ice-covered rivers and streams, especially in the Northeast and upper Midwest

Report Documentation Page

Report Date	Report Type	Dates Covered (from... to)
00 Dec 1999	N/A	-

Title and Subtitle Ice Jams, Winter 1998-1999	**Contract Number**
	Grant Number
	Program Element Number
Author(s)	**Project Number**
	Task Number
	Work Unit Number
Performing Organization Name(s) and Address(es) USACE Engineer Research and Development Center Cold Regions Research and Engineering Laborator 72 Lyme Road Hanover, New Hampshire 03755-1290	**Performing Organization Report Number**
Sponsoring/Monitoring Agency Name(s) and Address(es)	**Sponsor/Monitor's Acronym(s)**
	Sponsor/Monitor's Report Number(s)

Distribution/Availability Statement
Approved for public release, distribution unlimited

Supplementary Notes
The original document contains color images.

Abstract

Subject Terms

Report Classification unclassified	**Classification of this page** unclassified
Classification of Abstract unclassified	**Limitation of Abstract** UU

Number of Pages
4

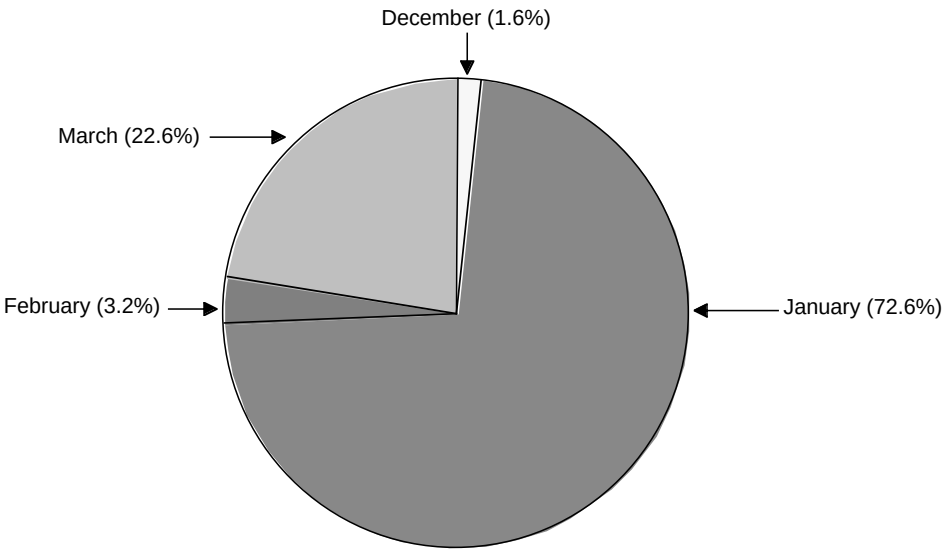

Figure 2. Months in which ice jams were reported, December 1998 through March 1999.

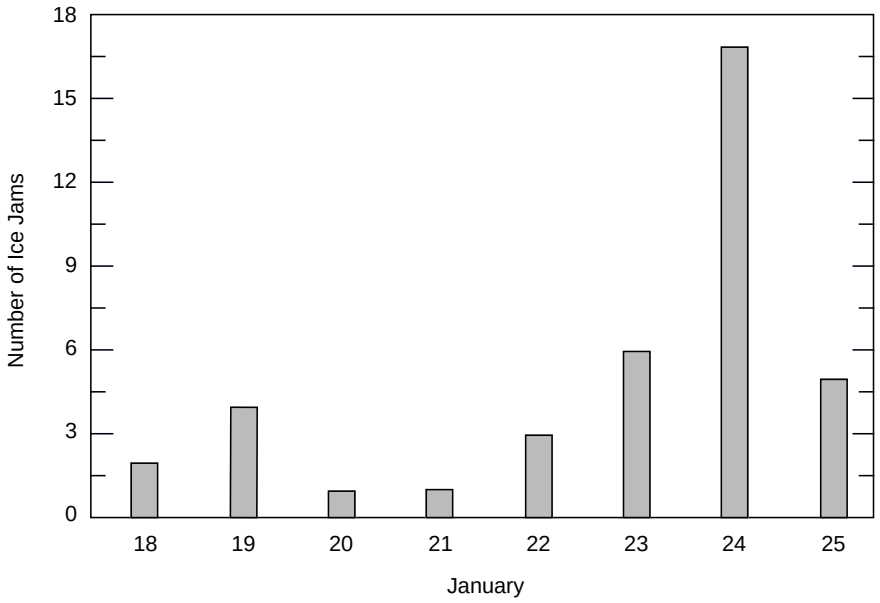

Figure 3. Ice jams during January 1999.

(water.usgs.gov/nwc/NWC/html/back_issues/wy99/jan99_cov.html). Widespread flooding resulted as snowpacks melted, creating rapid runoff leading to ice-cover breakup and ice jams. Combined with ice jams and frozen, saturated ground, runoff created extensive damage to riverine communities.

Where did ice jams occur in 1999?

Ice jams during water year 1999 affected 16 states, with New York and Pennsylvania being affected most frequently (Fig. 4 and 5). The rivers with the most entries in the ice jam database were the Housatonic and Mohawk Rivers.

Probably the most devastating ice jam of water year 1999 occurred on the first branch of the White River in Tunbridge, Vermont. On 4 and 5 March, the 116-year-old Tunbridge Mill covered bridge was destroyed by ice, and the surrounding areas were flooded. The problem on the White River actually began in the middle of January when upstream ice broke up near Chelsea and jammed at the Tunbridge Fairgrounds downstream from the historic covered bridge. This jam caused no problems, but remained in place. During subsequent cold weather, additional ice grew upstream. This ice broke up and moved during the March rainfall and thaw. The ice was stopped by the existing jam and was forced under the bridge. The structure was pushed off its abutments, and an adjoining building was surrounded by ice and flooded (Fig. 1). Sheep, oxen, and dairy barns at the fairgrounds also were knocked off their foundations by the flooding (Herrin 1999).

Experts were called in to devise a plan to try to rescue the bridge, but the necessary equipment was not available. On the morning of Friday, 5 March, the bridge was resting partially on its old abutments and partially on the ice. Attempts were still being made to save the bridge, but soon after noon the ice jam began to settle and move, carrying the bridge with it. A last-minute rescue was attempted, but much of the equipment had still not arrived and the bridge crashed into the frozen river (Farnham 1999). The bridge was insured for $100,000; although total damages have not been calculated, it is known that this amount is not enough to replace the historic structure (Herrin 1999).

An ice jam on the Ammonoosuc River in New Hampshire necessitated another evacuation. On 24 January, the day on which the most ice jams were reported in January, the Ammonoosuc River threatened the town of Littleton. Rains of the previous few days and warm weather melted ice and snow, causing the river to overflow (Associated Press 1999). An upstream ice jam failed and the surge of water and ice broke through the flashboards at the Apthorp Dam before flowing toward an elderly housing complex, 150 feet away. About 40 elderly residents were evacuated as a safety precaution and one elderly woman who attempted to move her vehicle to avoid damage had to be rescued from the rising water (White 1999b). The flood waters reached the parking lot and front doors of the apartment buildings before receding. Water did not reach the apartments, but ice damaged several of the parked

cars. Similar incidents have occurred in recent years. No major flooding was reported and the weather turned colder overnight, stopping much of the melting (Associated Press 1999).

While these two ice jams caused the most damage and threat to local residents, a vast majority of the 1999 ice jams occurred in the state of New York. Large amounts of rainfall, melting snow, and ice during the month of January caused flooding over much of eastern New York and western New England. Because of slightly warmer temperatures, the ice cover broke up and a large jam formed on the Hoosic River between Eagle Bridge and Johnsonville near Buskirk on 19 January. The jam remained in place until the 24th, when it moved downstream into a reservoir. The banks overflowed onto Route 103 and River Road, forcing them to close. Minor lowland flooding also occurred, affecting several low-lying homes in the area.

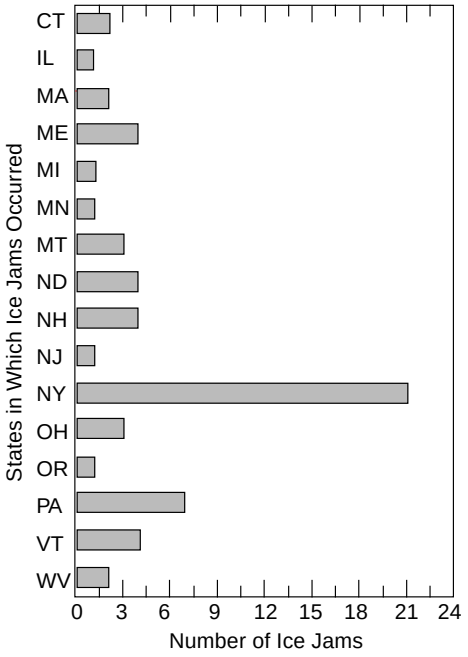

Figure 4. Number of ice jams in states during 1999.

Corps response

During the 1999 ice jam season, the U.S. Army Corps of Engineers provided resources and technical assistance to alleviate flood damage to affected communities. CRREL provided technical assistance in the form of advice, referrals, and trips to visit ice jams in New Hampshire, Vermont, Ohio, Illinois, Massachusetts, and West Virginia. Examples of Corps and CRREL response are described below.

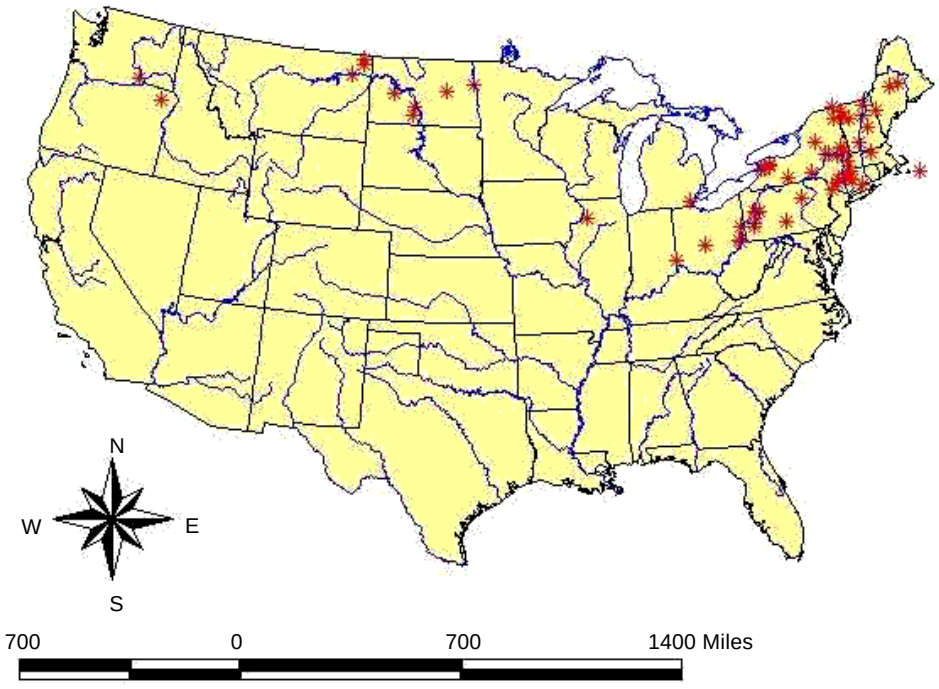

Figure 5. Location of ice jams in the United States during 1999, reported in the CRREL Ice Jam Database.

On 13 January 1999, Jon Zufelt of CRREL's Ice Engineering Research Division traveled to Parkersburg, West Virginia, at the request of the Huntington District Corps of Engineers, to provide assistance on an ice jam in the Little Kanawha River. A small reach of refrozen broken ice spanned the river at River Mile (RM) 3.5 and extended upstream for approximately 500 yards (Zufelt 1999). A significant jam also existed from RM 4.1 (I-77 overpass) upstream to at least RM 7. The Little Kanawha River is a navigable river, so it was important that the jam be broken so that navigation could continue. The ice jam consisted mainly of refrozen rafted pieces of broken ice with a total thickness of about one foot. A towboat was used to break the accumulation into large pieces by pushing the cover into a mooring cell or into ice that was grounded along the shore (Zufelt 1999). The intention was for the large pieces to float downstream into the Ohio River.

At the I-77 bridge near the toe of the jam, there were areas where the jam was six feet thick. The towboat was able to break up ice in this area by directing the propwash toward the edge of the jam and flushing ice from beneath the jam. The technique of approaching the edge of the ice at full speed and then putting the tow in full reverse just before hitting the edge was also used. This cracked the ice into smaller pieces that the tow could easily push downstream, but this was an extremely slow process that took two full days. The air temperatures and mild precipitation were favorable for the ice-breaking operation, and the towboat and Corps assistance greatly hastened the clearing and were instrumental in unblocking the channel.

The Corps is not only involved in ice jam clearing, but also gives advice to towns on what actions to take to mitigate ice jams. For example, Scott E. Acone of the New England District provided technical assistance to the Town of Westminster, Massachusetts, regarding a breakup ice jam that had formed 24 January 1999 on Phillips Brook, a tributary to the North Nashua River. There was an

additional ice jam just over a mile above this jam. Both jams were slowly moving downstream, but if the upstream jam moved into the downstream jam, the additional shoving of the ice could further restrict flow through the jam, worsening flooding (Acone 1999). Acone recommended monitoring the upstream jam for movement using several stations marked on trees. He also recommended the town try to push the ice on the downstream side of the bridge out into the floodplain with a tracked excavator or a small crane to alleviate the immediate flood threat to homes on the upstream side of the bridge.

How is this information helpful?

This overview of 1999 ice jams is the fourth entry in a series of yearly ice jam summaries. We plan to update the Ice Jam Database for each year and provide a publication that summarizes when and where ice jams occurred, resulting damages, and the Corps response. These types of historical data are crucial during emergency situations when information about ice jam locations or stages would be helpful, and are also useful for predicting ice jams. For example, if similar weather conditions occur in the future as they did in 1999, one can access information on ice jams and 1999 to determine the most likely jam areas and thus carry out appropriate mitigation techniques.

CRREL also has an Ice Jam Archive containing hard copies of the NWS reports, newspaper articles, and other reports used as sources for ice jam data for 1999 and other years in the database. The information can be checked out or photocopied for research.

Acknowledgments

This work was supported by funding from Work Unit #32774, *Field Monitoring of Ice Jams*, Civil Works Ice Engineering Research Program.

Please send any information for inclusion in the Ice Jam Database or Ice Jam Archive to Lourie Herrin, Ice Engineering Research Division, CRREL, 72 Lyme Road, Hanover, NH 03755-1290. Photocopies of originals can be made and returned.

The CRREL Ice Jam Database is available via the CRREL home page (http://www.crrel.usace.army.mil/).

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This edition of Ice Engineering *was written by Deanna Kasperski and Kate White, Research Hydraulic Engineer, Ice Engineering Research Division (IERD), U.S. Army Cold Regions Research and Engineering Laboratory (CRREL), and was edited by Gioia Cattabriga and laid out by John D. Severance of CRREL's Technical Information Branch. Ms. Kasperski, a student at Dartmouth College, worked on the database as an intern in the Women in Science Program (WISP).*

Ice Engineering Information Exchange Bulletin

The *Ice Engineering Information Exchange Bulletin* is published in accordance with AR 25-30 as one of the information exchange functions of the Corps of Engineers. It is primarily intended to be a forum whereby information on ice engineering work done or managed by Corps field offices can be disseminated to other Corps offices, other U.S. Government agencies, and the engineering community in general. The purpose of the *Ice Engineering Information Exchange Bulletin* is information exchange and not the promulgation of Corps policy; thus, guidance on recommended practice in any given area should be sought through appropriate channels or in other documents. This bulletin's contents are not to be used for advertising, publication, or promotional purposes. Citation of trade names does not constitute an official endorsement or approval of the use of such commercial products.

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Communications are welcomed. Write to CRREL, ATTN: J.-C. Tatinclaux (CEERD-RI), 72 Lyme Road, Hanover, NH 03755-1290, or call 603-646-4361.